body and then can be otherwise worked as desired.

In the event an alloy is to be produced, the alloying metal or metals can be supplied to the chamber 11 at the beginning of the process, or at some other desired point of the process, and I may supply the metal or metals themselves, or compounds of the metals, such as oxides, the right amount being added in each instance to obtain the desired content of the alloying metal or metals. The alloying metal or metals, whether in a pure metallic state, or in the form of compounds, such as oxides, are preferably added to the chamber 11 with the iron or steel scrap, the process being otherwise the same as that utilized for the production of steel.

Whether the alloying metal or metals are supplied in a metallic state or in the form of oxides, in the reducing step the oxide or oxides will be reduced along with the iron oxide to the metallic state, and after the carbonizing step there is practically a perfect and uniform mixture of finely divided steel and the metal or metals to be alloyed therewith. However, with alloying metals which can not be reduced as readily as oxide of iron, the finely divided metal or metals will be added after the reducing step, to the finely divided metallic iron, and thoroughly mixed therewith, after which the carbonizing step is carried out as in the production of steel, or the mixing can be conducted after the carbonizing step.

The process is then continued precisely as explained in connection with the production of steel. That is to say, the thoroughly mixed metals are compressed in a press under suitable severe pressure to form a dense bar or ingot which is subsequently heated to welding temperature and then forged to produce the alloying and for the purpose of working the bar or ingot into the desired shape, or the mixed metals can be molded into the desired shape of the finished article in a press capable of subjecting the materials to a sufficiently high pressure and then the alloying can be accomplished by heating the molded articles and allowing them to cool either gradually or suddenly, as by quenching them if they are to be tempered. In thus alloying the compressed articles the molded article whether or not in the form of a bar, is heated to a point which does not exceed the melting temperature of the least refractory metal.

It will be seen therefore, that by the above process I am enabled to produce iron, steel, or steel alloy, whether or not in the shape of the final article to be produced, with the steel having the precise or exact carbon content desired, and with the alloy having the desired metal content, and this is accomplished without any melting of smelting process. Furthermore, the article is homogeneous chemically and physically, especially when it is forged into an absolutely non-porous body, and as the product is absolutely free from such imperfections as blow-holes, common in casting, as there is a complete absence of so-called segregations, a high grade product is obtained.

I might say in conclusion, that any of the usual steel alloys can be produced, the process being very well adapted for the production of alloys from iron and any of the metals which alloy therewith, such as tungsten, nickel, cobalt, molybdenum, etc.

Above I have described the preferred way of carrying out the process for the production of iron, steel, or steel alloys, including the several steps which can be carried out in sequence when starting with iron and steel scrap, but I wish it to be understood that I am not to be limited to the combination of steps herein recited, as one or more of them may be used advantageously without others.

Having described my invention, I claim:

1. The process which comprises oxidizing iron or steel scrap so as to produce iron oxide in finely divided form, reducing the oxide to powdered metallic iron, and subsequently treating the metallic iron so as to produce a solid metallic body.

2. The step in the process of producing iron or steel without melting or smelting, which comprises agitating iron or steel scrap in a heated container in the presence of an oxidizing medium so as to produce oxide of iron in finely divided form.

3. The steps in the process of producing iron or steel bodies which comprise agitating iron or steel scrap in a heated container in the presence of an oxidizing medium so as to produce iron oxide in finely divided form, and subsequently subjecting the oxide to the action of a reducing gas so as to produce finely divided metallic iron.

4. The steps in the process of producing iron or steel bodies which comprise agitating iron or steel scrap in a heated container in the presence of an oxidizing medium so as to produce iron oxide in finely divided form, subjecting the oxide to the action of a reducing gas so as to produce finely divided metallic iron, and subsequently compressing the finely divided material into a solid body.

5. The step in the process of making steel which comprises subjecting metallic iron in finely divided form to the action of a carbonizing gas.

6. The step in the process of making steel which comprises agitating finely divided metallic iron in a heated container in the presence of a carbonizing gas.

7. The process of making steel which comprises converting iron or steel scrap to oxide of iron, treating this so as to produce finely divided metallic iron, and carbonizing the